DETAILED ACTION

1. This application was held abandoned for failure to replay to the non-final office action mailed March 24,2009. A notice of Abandonment was mailed on October 15,2009. Applicant filed a petition on October 20, 2009 requesting to withdraw holding of the abandonment. The petition is **Granted** on 12/29/2009. Thus, the **abandonment is withdrawn** and the non-final office action which was originally mailed on March 24,2009 is as follow;

Continued Examination Under 37 CFR 1.114

2. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 01/12/2009 has been entered.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of

the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

5. Claims 1-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ishikawa (US 6,254,213) in view of Matsuo et al. (US 6,488,349).

Regarding claim 1, Ishikawa teaches an image formation apparatus (figs.8,9 and controller 625 in fig.4) capable of forming a relatively large ink drop by sequentially discharging a plurality of ink drops from an ink drop discharging head (600), the image formation apparatus (figs.4,8,9) comprising:

pressure generating means (603,619,621, figs.8) for discharging one or more of the sequential ink drops other than an ink drop that is not followed by any more of the ink drops in a given printing cycle (the last ink drop) at an interval substantially equal to (n+1/2) x Tc but not equal to n x Tc, wherein the interval at which said one or more of the sequential ink drops is discharged in said given printing cycle is substantially equal to (n x Tc) + (Tc/2) but not equal to n x Tc, such that the sequential ink drops merge before reaching a print target medium (paragraph 0119) (**Examiner Note**, (n x Tc) + (Tc/2) = (n + 1/2) x Tc i.e. the two limitations are exactly the same), where n is an integer equal to or greater than 1, and Tc represents a resonance cycle of a pressurized ink chamber of the image formation apparatus, the interval being measured from when

a corresponding preceding ink drop is discharged (the driving wave form in fig.1 is applied to the electrodes of the ink drop discharge head 600 by the controller 625 in fig.4. The interval between the ink drop ejecting pulses in fig.1 is equal to (N + 0.5) x T).

Ishikawa does not expressly teach the sequential ink drops merges before reaching a print target medium.

However, from the same endeavor Matsuo et al teaches merging sequential ink drops (figs.7,14) before reaching a print target medium (41, fig.1) in order to form large ink drop. The ink drops are merged by ejecting the ink drops such that the later discharged ink droplet has a higher discharge velocity than that of a previously discharged ink droplet for example by adjusting voltage amplitude as shown in figs.16 and 17 (see also col. 23 line 16- col.24 line 33; by increasing the magnitude of the voltage applied so that the later discharged ink droplet has higher discharge velocity than that of the a previously discharged droplet) (also by adjusting other parameters of the wave forms as shown in figs.12,13, and 15).

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the driving wave form of Ishikawa (fig.1) to cause ejections such that the sequential ink drops ejected merges before reaching a print target medium during formation of large ink drops based on the teachings of Matsuo et al (figs.14, 16, 17). The motivation is to form large ink drops and since all of the merged ink drops reaches the recording medium at the same time (at once), the merged ink drops dry uniformly which improves the uniformity, quality, of the large ink drops formed thereby enhancing the printing image quality.

Regarding claim 2, Ishikawa further teaches wherein one or more of the ink drops other than the last ink drop are discharged at an interval substantially equal to 1.5 x Tc (see fig.1, when the value of the integer N is set to be equal to 1, then the interval between the pulses becomes 1.5 x Tc).

Regarding claim 3, Ishikawa further teaches ink drops other than the one or more ink drops that are discharged at an interval substantially equal to (n+1/2) x Tc (interval (N + 0.5) x T between the ink drop ejecting pulses in fig.1) are discharged at an interval nearly equal to n x Tc (see figs.2B, 3B, 6B, and 6C; shows interval equal to even or odd integer times Tc).

Regarding claim 4, Ishikawa further teaches wherein a first ink drop is discharged by the pressurized ink chamber (613, fig.8) being contracted after being expanded, where a volume of contraction is greater than a volume of expansion, and where the volume of expansion may take a positive value or zero (in the ink drop discharge head 600 of figs.8,9, ink drops are ejected by first expanding the chamber 613 as shown in fig.9, then by contracting the chamber to its original position as shown in fig.8. see col.1, line 61- col.2, line 32 of Ishikawa. The amount of expansion and contraction can be controlled by the voltage applied to the electrodes. see figs.7B, 8, 9, 16 of Matsuo et al).

Regarding claim 5, Ishikawa further teaches a second ink drop is discharged at an interval substantially equal to (n+1/2) x Tc from the first ink drop that precedes the second ink drop (the interval between the first, second, third,…, ejecting pulses in fig.1 is equal to (N + 0.5) x T).

Regarding claim 6, Ishikawa further teaches wherein the speed of ink drops is set at greater than three m/s (see figs.2 and 3, the speed of the ink drops is 5-9 m/s in fig.2 and 20-60 in fig.3).

Regarding claim 7, Ishikawa as modified by Matsuo et al. further teaches wherein four or more of the sequential ink drops merge during flight to form one of the relatively large ink drops (Matsuo et al in figs.7, and 14 teaches the merging of 3 ink droplets to form large ink drop Q123, figs.12b, 13b, 15b, 16b, 17b teaches how to select the required number of ejecting pulses that merges to from large ink drop. Thus it is obvious to form a large ink drop by merging four or more ink drops depending on the size of the large ink drop and the merging ink drops).

Regarding claim 8, Ishikawa as modified by Matsuo et al further teaches a waveform containing driving pulses (fig.1of Ishikawa, figs.16, 17 of Matsuo et al) for discharging the sequential ink drops includes a waveform for suppressing a residual vibration after a driving pulse for discharging the last ink drop (S13 in fig.9, P15 in fig.11 of Matsuo et al).

Regarding claim 9, Ishikawa as modified by Matsuo et al further teaches the waveform for suppressing the residual vibration (S13 in fig.9, P15 in fig.11 of Matsuo et al) is provided within an elapsed time equivalent to Tc after the last ink drop is discharged (fig.1of Ishikawa).

Regarding claim 10, Ishikawa as modified by Matsuo et al further teaches a medium-sized ink drop and a small-sized ink drop are each formed by selecting a part of driving pulses for forming the relatively large ink drop (see fig.3 of Ishikawa teaches droplets of different volume. fig.14 of Matsuo et al teaches small ink drops Q1 and Q2 formed a medium size drop Q12 and a small drop Q3 and medium drop Q12 forms large drop Q123).

Regarding claim 11, Ishikawa as modified by Matsuo et al further teaches the driving pulses include a waveform for vibrating a meniscus without causing an ink drop to be discharged (S13 in fig.9, P15 in fig.11 of Matsuo et al).

Regarding claim 12, Ishikawa as modified by Matsuo et al further teaches the driving pulses (fig.1 of Ishikawa) include a section wherein a voltage is applied to the pressure generating means (603,619 of fig.8) for pressurizing ink in the pressurized ink chamber (613) (see also figs. 6-9,11,16 of Matsuo et al).

Regarding claim 13, Ishikawa as modified by Matsuo et al further teaches the pressure generating means (603,619 of fig.8 of Ishikawa) is a piezoelectric device, and the piezoelectric device (603,619) is recharged in the section wherein said voltage is applied (figs.8,9;col.8, lines 10-25).

Regarding claim 14, Ishikawa as modified by Matsuo et al further teaches wherein the pressure generating means (603,619 of fig.8 of Ishikawa) for generating the pressure for pressurizing the ink of the pressurized ink chamber is a piezoelectric device, a displacement direction of which is d33 (figs.9; col.8, lines 10-25).

Regarding claim 15, Ishikawa as modified by Matsuo et al further teaches support sections (619 in fig.8 of Ishikawa; 15 in fig.5 of Matsuo et al) of the piezoelectric device (603,619 in fig.8 of Ishikawa; 13 in fig.5 of Matsuo et al) support partitions of the pressurized ink chamber (613 in fig.8 of Ishikawa; 4 in fig.5 of Matsuo et al).

Regarding claim 16, Ishikawa as modified by Matsuo et al further teaches wherein additional ink drops other than the one or more ink drops that are discharged at an interval substantially equal to (n+1/2) x Tc are discharged at an interval substantially equal to n x Tc, and said additional ink drops merge with the one or more ink drops that are discharged at an interval nearly equal to (n+1/2) x Tc (see fig.1 of Ishikawa, plurality of ink droplets are ejected due to the application of the driving wave form. The interval between the ink drop ejecting pulses in fig.1 is equal to (N + 0.5) x T where N is an

integer and the value of interval (N + 0.5) x T is <u>substantially</u> equal that of N x T especially for high integer values of N. The plurality of ejected ink drops merge in flight forming large ink drop, Matsuo et al. Note also the limitation “merge” in this claim does not specifically mention the location of the merge, so the merge can be interpreted to mean the claimed ink drops ejected merge on the medium surface, which is obviously true irrespective of the time interval between the drops).

Regarding claim 17, Ishikawa as modified by Matsuo et al further teaches wherein a predetermined interval between first and second ink drops of the sequential ink drops is substantially equal to1.5 x Tc such the first and second ink drops merge before reaching a print target medium (see fig.1 of Ishikawa, the interval between the ink drop ejecting pulses in fig.1 is equal to (N + 0.5) x T where N is an integer and the value of interval (N + 0.5) x T for N is equal to 1 is equal to 1.5 x T).

6. Claims 1-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kusunoki (US 2003/0001912) in view of Matsuo et al. (US 6,488,349).

Regarding claim 1, Kusunoki ‘912 teaches an image formation apparatus (fig.3) capable of forming a relatively large ink drop by sequentially discharging a plurality of ink drops from an ink drop discharging head (1, figs.1-3), the image formation apparatus (fig.3) comprising:

pressure generating means (15, figs.1-2) for discharging one or more of the sequential ink drops other than an ink drop that is not followed by any more of the ink drops in a given printing cycle (the last ink drop) at an interval substantially equal to (n+1/2) x Tc but not equal to n x Tc, wherein the interval at which said one or more of the sequential ink drops is discharged in said given printing cycle is substantially equal to (n x Tc) + (Tc/2) but not equal to n x Tc, such that the sequential ink drops merge before reaching a print target medium (paragraph 0119) (**Examiner Note**, (n x Tc) + (Tc/2) = (n + 1/2) x Tc i.e. the two limitations are exactly the same), where n is an integer equal to or greater than 1, and Tc represents a resonance cycle of a pressurized ink chamber of the image formation apparatus, the interval being measured from when a corresponding preceding ink drop is discharged (see fig.10, the interval between the consecutive ejecting pulses P2' is substantially equal to 1.5 x Tc which is equal to (1+1/2) x Tc ; see fig.11 the interval between the consecutive ejecting pulses P2" is equal to 1.5 x Tc which is equal to (1+1/2) x Tc; see fig.8, the interval between the consecutive ejecting pulses P2 is equal to 2.5 x Tc which is equal to (2+1/2) x Tc).

Kusunoki '912 does not expressly teach the sequential ink drops merges before reaching a print target medium.

However, from the same endeavor Matsuo et al teaches merging sequential ink drops (figs.7,14) before reaching a print target medium (41, fig.1) in order to form large ink drop. The ink drops are merged by ejecting the ink drops such that the later discharged ink droplet has a higher discharge velocity than that of a previously discharged ink droplet for example by adjusting voltage amplitude as shown in figs.16

and 17 (see also col. 23 line 16- col.24 line 33; by increasing the magnitude of the voltage applied so that the later discharged ink droplet has higher discharge velocity than that of the a previously discharged droplet) (also by adjusting other parameters of the wave forms as shown in figs.12,13, and 15).

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the driving wave form of Kusunoki ‘912 (figs.8, 10, 11) to cause ejection such that the sequential ink drops ejected merges before reaching a print target medium during formation of large ink drops based on the teachings of Matsuo et al (figs.14, 16, 17). The motivation is to form large ink drops and since all of the merged ink drops reaches the recording medium at the same time (at once), the merged ink drops dry uniformly which improves the uniformity, quality, of the large ink drops formed thereby enhancing the printing image quality.

Regarding claim 2, Kusunoki ‘912 further teaches wherein one or more of the ink drops other than the last ink drop are discharged at an interval substantially equal to 1.5 x Tc (see fig.10, the interval between the consecutive ejecting pulses P2' is substantially equal to 1.5 x Tc; see fig.11 the interval between the consecutive ejecting pulses P2'' is equal to 1.5 x Tc).

Regarding claim 3, Kusunoki ‘912 further teaches ink drops other than the one or more ink drops that are discharged at an interval nearly equal to (n+1/2) x Tc (see fig.10, the interval between the consecutive ejecting pulses P2' is substantially equal to

(1+1/2) x Tc ; see fig.11 the interval between the consecutive ejecting pulses P2" is equal to (1+1/2) x Tc; see fig.8, the interval between the consecutive ejecting pulses P2 is equal to (2+1/2) x Tc) are discharged at an interval substantially equal to n x Tc (see fig. 4, the interval between the consecutive ejecting pulses P2 is equal to 2 x Tc; Furthermore, in figs.8,10,11, the intervals 2.5 x Tc, 1.5 x Tc, 1.5 x Tc respectively are also substantially equal to n x Tc).

Regarding claim 4, Kusunoki '912 further teaches wherein a first ink drop is discharged by the pressurized ink chamber (11, fig.1) being contracted (by pulses P2 in figs.4,8,10,11) after being expanded (by pulses P1 in figs.4,8,10,11), where a volume of contraction (by pulses P2 in figs.4,8,10,11) is greater than a volume of expansion (by pulses P1 in figs.4,8,10,11), and where the volume of expansion may take a positive value or zero (see figs. 4,8,10,11 the expansion of chamber 11 due to pulses P1 takes a positive or zero value, and the amount of expansion and contraction can be controlled by controlling the amplitude and/or the width of pulses P1 and P2 as shown in figs.10,11 of Kusunoki and figs.7B,8,9, 16 of Matsuo et al).

Regarding claim 5, Kusunoki '912 further teaches a second ink drop is discharged at an interval substantially equal to (n+1/2) x Tc from the first ink drop that precedes the second ink drop (in fig.10, the interval between the consecutive ejecting pulses P2' is substantially equal to (1+1/2) x Tc ; in fig.11 the interval between the

consecutive ejecting pulses P2" is equal to (1+1/2) x Tc; in fig.8, the interval between the consecutive ejecting pulses P2 is equal to (2+1/2) x Tc).

Regarding claim 6, Kusunoki '912 substantially teaches the claimed invention (see the rejections above and fig.9) except for the speed of one of the ink drops is set at greater than 3 m/s, and at a speed at which the sequential ink drops are merged. It would have been obvious to one having ordinary skill in the art at the time the invention was made to eject an ink drop at greater than 3 m/s, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. In re Aller, 105 USPQ 233

Regarding claim 7, Kusunoki '912 as modified by Matsuo et al. further teaches wherein four or more of the sequential ink drops merge during flight to form one of the relatively large ink drops (Matsuo et al in figs.7, and 14 teaches the merging of 3 ink droplets to form large ink drop Q123, figs.12b, 13b, 15b, 16b, 17b teaches how to select the required number of ejecting pulses that merges to from large ink drop. Thus it is obvious to form a large ink drop by merging four or more ink drops depending on the size of the large ink drop and the merging ink drops).

Regarding claim 8, Kusunoki '912 as modified by Matsuo et al further teaches a waveform containing driving pulses (figs.4, 8, 10,11of Kusunoki, figs.16, 17 of Matsuo et al) for discharging the sequential ink drops includes a waveform for suppressing a

residual vibration after a driving pulse for discharging the last ink drop (S13 in fig.9, P15 in fig.11 of Matsuo et al).

Regarding claim 9, Kusunoki ‘912 as modified by Matsuo et al further teaches the waveform for suppressing the residual vibration (S13 in fig.9, P15 in fig.11 of Matsuo et al) is provided within an elapsed time equivalent to Tc after the last ink drop is discharged (figs.4, 8, 10,11of Kusunoki).

Regarding claim 10, Kusunoki ‘912 as modified by Matsuo et al further teaches a medium-sized ink drop and a small-sized ink drop are each formed by selecting a part of driving pulses for forming the relatively large ink drop (in fig.14 Matsuo et al teaches small ink drops Q1 and Q2 forming a medium size drop Q12 and a small drop Q3 and medium drop Q12 forming large drop Q123).

Regarding claim 11, Kusunoki ‘912 as modified by Matsuo et al further teaches the driving pulses include a waveform for vibrating a meniscus without causing an ink drop to be discharged (S13 in fig.9, P15 in fig.11 of Matsuo et al).

Regarding claim 12, Kusunoki ‘912 as modified by Matsuo et al further teaches the driving pulses (figs.4, 8, 10,11of Kusunoki) include a section wherein a voltage is applied to the pressure generating means (15 figs.1-2) for pressurizing ink in the pressurized ink chamber (11) (see also figs. 6-9,11,16 of Matsuo et al).

Regarding claim 13, Kusunoki ‘912 as modified by Matsuo et al further teaches the pressure generating means (15,figs.1,2 of Kusunoki) is a piezoelectric device, and the piezoelectric device (15) is recharged in the section wherein said voltage is applied (figs.4, 8, 10,11).

Regarding claim 14, Kusunoki ‘912 as modified by Matsuo et al further teaches wherein the pressure generating means (15, figs.1, 2 of Kusunoki) for generating the pressure for pressurizing the ink of the pressurized ink chamber is a piezoelectric device, a displacement direction of which is d33 (see figs.4, 8, 10, 11; chamber 11 is contracted in inward direction when pulses P2 are applied to pressure generating means 15).

Regarding claim 15, Kusunoki ‘912 as modified by Matsuo et al further teaches support sections (14, figs.1, 2 of Kusunoki; 15 in fig.5 of Matsuo et al) of the piezoelectric device (15 figs.1, 2 of Kusunoki; 13 in fig.5 of Matsuo et al) support partitions of the pressurized ink chamber (11 figs.1, 2 of Kusunoki; 4 in fig.5 of Matsuo et al).

Regarding claim 16, Kusunoki ‘912 as modified by Matsuo et al further teaches wherein additional ink drops other than the one or more ink drops that are discharged at an interval substantially equal to (n+1/2) x Tc are discharged at an interval substantially

equal to n x Tc, and said additional ink drops merge with the one or more ink drops that are discharged at an interval nearly equal to (n+1/2) x Tc (see fig.10, the interval between the consecutive ejecting pulses P2' is substantially equal to (1+1/2) x Tc ; see fig.11 the interval between the consecutive ejecting pulses P2" is equal to (1+1/2) x Tc; see fig.8, the interval between the consecutive ejecting pulses P2 is equal to (2+1/2) x Tc. See also fig. 4, the interval between the consecutive ejecting pulses P2 is equal to 2 x Tc; Furthermore, in figs.8, 10, 11, the intervals 2.5 x Tc, 1.5 x Tc, 1.5 x Tc respectively which are substantially equal to n x Tc).

Regarding claim 17, Kusunoki '912 as modified by Matsuo et al further teaches wherein a predetermined interval between first and second ink drops of the sequential ink drops is substantially equal to1.5 x Tc such the first and second ink drops merge before reaching a print target medium (see fig. 4, the interval between the consecutive ejecting pulses P2 is equal to 2 x Tc; Furthermore, in figs.8,10,11, the intervals 2.5 x Tc, 1.5 x Tc, 1.5 x Tc respectively are also equal and/or substantially equal to 1.5 x Tc).

Response to Arguments

7. Applicant's arguments filed on 01/12/2009 have been fully considered but they are not persuasive. See the two sets of rejections of claims 1-17 including the new limitation in claim 1.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to HENOK LEGESSE whose telephone number is (571)270-1615. The examiner can normally be reached on Mon.- Fri. Between. 8:00 AM-6:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, MATTHEW LUU can be reached on (571)272-7663. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/MATTHEW LUU/
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H.L.
01/15/2010